AIMS African Institute for Mathematical Sciences GHANA

Alexander von Humboldt Stiftung/Foundation

German Research Chair @AIMS Ghana

Online Public Lecture

13 December, 2021/ 10:00 – 16:30 (UCT+0)

Chaired by Dr. Prince Osei of AIMS Ghana

10:00 (UCT+0)

Prof. Dr. Jules Djoko Kamdem, National Research Foundation (NRF), African Peer Review Mechanism, Johannesburg, South Africa

Numerical Methods for Stokes (Navier Stokes) equations under nonlinear slip boundary conditions

In this presentation, we discuss the numerical solution of Stokes and Navier Stokes equations governed by nonlinear slip boundary conditions.

We formulate the variational problems and discuss their solvability (Faedo-Galerkin Brouwer's fixed point, compactness properties). Next, one considers the Stokes problem and formulate an equivalent saddle point problem with a well-chosen augmented Lagrangian.To solve this saddle point problem, we advocate an alternating direction method of multiplier (ADMM) together with finite element approximations. The solution of the Navier Stokes equations combines finite element approximations, time discretization by operator splitting and augmented Lagrangian method. Numerical experiment results for two- and three-dimensional flow confirm the interest of these approaches.

11:00 (UCT+0)

Dr. Rhoda Joy Hawkins, University of Sheffield, Department of Physics and Astronomy, Sheffield, United Kingdom

Modelling cell mechanics and stochastic dynamics: From cancer cell migration to malaria invasion

In this talk I will show how I apply mathematics to biophysical systems of importance in disease. The mechanics, movement and deformation of biological cells is driven by stochastic Brownian motion and biochemical reactions. I will give microscopic descriptions using nonlinear stochastic differential equations and macroscopic descriptions using continuum mechanics, fluid dynamics and differential geometry. I will then explain how non-equilibrium statistical mechanics and probability theory connect the microscopic and macroscopic descriptions. I will illustrate this with examples from my own work on cell migration of cancer cells, immune cell interactions with pathogens and preliminary work on **invasion of red blood cells by the malaria parasite.**

UCT+0	UCT+1	UCT+2	
Ghana United Kingdom	Germany Austria	South Africa	Please note: All times indicated above are given in Ghanaian local time (UCT+0). Other relevant time zones please find below. The log-in links you will receive should automatically take possible time difference into account.
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13:30 (UCT+0)

Dr. Comlan Edmond Koudjinan, Institute of Science and Technology Austria, Mathematics and Computer Science Klosterneuburg, Austria

On non-coexistence of 2 & 3–rational caustics in nearly circular billiard table

A famous Birkhoff conjecture states that the only integrable convex planar billiards are billiards in an ellipse. We examined two closely related rigidity questions. A rational caustic is a caustic associated to a family of periodic orbits of the same period and the same rotation number. For example, a convex domain with a rational caustic of period two is a domain of a constant width. We investigated a question proposed by Tabachnikov: are there nearly circular domains other than discs with two rational caustics of a prime period p and q? In this talk, I will discuss our following two new results:

- (rigidity) There are no nearly circular domains with two coexisting rational caustics of period two and three
- (no super-rigidity) There may be infinitely many deformations of the circular domains with two coexisting rational caustics of period three and five with error given by the 15th power of the perturbation parameter.

This is based on a joint work with V. Kaloshin.

14:30 (UCT+0)

Dr. Prince Romeo Mensah, Imperial College London, Department of Mathematics, London, United Kingdom

Analysis of polymer fluids

We give a brief and accessible introduction into the modelling of polymer fluids. These are solute-solvent mixtures with unusual behaviours as compared to water, say. We then show the main ideas in establishing the existence of a unique solution, in a sense, of the underlying system in the simplified case of a dilute mixture which has a dumbbell looking polymer chain structure.

15:30 (UCT+0)

Prof. Dr. Nicholas Monk, University of Sheffield, School of Mathematics and Statistics, Sheffield, United Kingdom

The mathematics of cellular decision making

The dynamics of living systems depend on the ability of cells to make definitive changes in their state in response to their environment. I will describe mathematical approaches to studying this problem in plant and animal development, illustrating the importance of considering the interaction of multiple time scales.